

FINAL
1N-90-CR
OCT
6480
P-7

FINAL REPORT FOR THE INTERNATIONAL
SUN-EARTH EXPLORER 1 & 2 (ISEE 1 & 2)
MAGNETOSPHERIC AND INTERPLANETARY
PLASMA INSTRUMENTS

(Reference: NASA/GSFC Contract No. NAG5-1109)

Final Report for period 1989-1995

Prepared for: Goddard Space Flight Center
Greenbelt, Maryland 20771

L.A. Frank
Principal Investigator

Department of Physics and Astronomy
The University of Iowa
Iowa City, Iowa 52242

December 1995

N96-15856

Unclas

G3/90 0083954

(NASA-CR-199787) INTERNATIONAL
SUN-EARTH EXPLORER 1 AND 2 (ISEE 1
AND 2) MAGNETOSPHERIC AND
INTERPLANETARY PLASMA INSTRUMENTS
Final Report, 1989-1995 (Iowa
Univ.) 7 p

INSTRUMENT REPORT

During the 1989-1995 period the plasma instruments on board ISEE 1 and 2 were operational until the reentry into the Earth's atmosphere of both spacecraft. All data from the ISEE-1 LEPEDea instrument have been processed and submitted to NSSDC.

MAJOR ACCOMPLISHMENTS

- Two-spacecraft observation of transpolar arc and associated magnetotail source population.
- Observational determination of the equation of state for quiet-time plasma convection in the central plasma sheet.
- Statistical studies of the macroscopic properties of the plasma sheet, establishing spatial variations in plasma density, velocity, temperature and convective electric fields, with the auroral electrojet (AE) index. These studies showed that the plasma drift velocities are generally low, considerably smaller than plasma thermal speeds, and directed earthward at all levels of AE. Follow-up studies which divided up observations by phase of activity confirmed the earlier results based on AE.
- Statistical studies of the magnetic field in the neutral sheet of the magnetotail, showing that the average field strength in the neutral sheet is typically 7 nT, irrespective of level or phase of activity.
- First observation evidence of stochastic particle orbits in the neutral sheet of the magnetotail, leading to relative maxima and minima in the ion velocity distribution.

- Investigation of the Tsyganenko 1989 magnetic field model, showing that portions of the model involving the plasma sheet magnetic field beyond 20 RE yield unrealistic solutions.
- Study of wave-particle interactions in the earth's magnetotail, showing the existence of ULF perturbations in the plasma sheet boundary layer, confirmed by theoretical analysis.
- Detailed study of ion velocity distributions in the magnetosheath, showing that low-frequency waves can be generated by a marginally unstable ion population.
- Multi-instrument study of magnetic topology of the low-latitude boundary layer along the flanks, showing that the field lines are closed.
- Detailed study of the central plasma sheet during substorm onset showing that the main effect of substorm activity is to increase the thermal energy of the plasma, and that this process must be nonadiabatic.

Publications

- Huang, C. Y., J. D. Craven, and L. A. Frank, Simultaneous observations of a theta aurora and associated magnetotail plasmas, *J. Geophys. Res.*, **94**, 10137, 1989.
- Nishikawa, K. -I., L. A. Frank, and C. Y. Huang, Simulation of whistler mode excited by the Spacelab 2 electron beam, *J. Geophys. Res.*, **94**, 6855, 1989.
- Huang, C. Y., C. K. Goertz, L. A. Frank, and G. Rostoker, Observational determination of the adiabatic index in the quiet time plasma sheet, *Geophys. Res. Lett.*, **16**, 563, 1989.
- Angelopoulos, V., R. C. Elphic, S. P. Gary, and C. Y. Huang, Electromagnetic instabilities in the plasma sheet boundary layer, *J. Geophys. Res.*, **11**, 15373, 1989.
- Christon, S. P., D. J. Williams, D. G. Mitchell, L. A. Frank, and C. Y. Huang, Spectral characteristics of plasma sheet ion and electron populations during undisturbed geomagnetic conditions, *J. Geophys. Res.*, **94**, 13409, 1989.
- Chen, J., G. R. Burkhart, and C. Y. Huang, Observational signatures of nonlinear magnetotail particle dynamics, *Geophys. Res. Lett.*, **17**, 2237, 1990.
- Mitchell, D. G., D. J. Williams, C. Y. Huang, L. A. Frank, and C. T. Russell, Current carriers in the near-Earth cross-tail current during substorm growth phase, *Geophys. Res. Lett.*, **17**, 583, 1990.
- Williams, D. J., D. G. Mitchell, C. Y. Huang, L. A. Frank, and C. T. Russell, Particle acceleration during substorm growth and onset, *Geophys. Res. Lett.*, **17**, 587, 1990.
- Christon, S. P., D. J. Williams, D. G. Mitchell, L. A. Frank, and C. Y. Huang, Spectral characteristics of plasma sheet ion and electron populations during disturbed geomagnetic conditions, *J. Geophys. Res.* **96**, 1, 1991.
- Traver, D. P., D. G. Mitchell, D. J. Williams, L. A. Frank, and C. Y. Huang, Two encounters with the flank low-latitude boundary layer: Further evidence for closed field line topology and investigation of the internal structure, *J. Geophys. Res.*, **96**, 21025, 1991.
- Huang, C. Y., Velocity distributions in the plasma sheet boundary layer, *Adv. Space Res.*, **11**, 143, 1991.
- Donovan, E. F., G. Rostoker, and C. Y. Huang, Regions of negative B_z in the Tsyganenko 1989 model neutral sheet, *J. Geophys. Res.*, **97**, 8697, 1992.

- Parks, G. K., R. Fitzenreiter, K. W. Ogilvie, C. Huang, K. A. Anderson, J. Dandouras, L. Frank, R. P. Lin, M. McCarthy, H. Reme, J. A. Sauvaud, and S. Werden, Low-energy particle layer outside of the plasma sheet boundary, *J. Geophys. Res.*, **97**, 2943, 1992.
- Huang, C. Y., L. A. Frank, G. Rostoker, J. Fennell, and D. G. Mitchell, Nonadiabatic heating of the central plasma sheet at substorm onset, *J. Geophys. Res.*, **97**, 1481, 1992.
- Lyons, L. R., and C. Y. Huang, Observations of plasma sheet expansion at substorm onset at $R = 15$ to 22 RE, *Geophys. Res. Lett.*, **19**, 1807, 1992.
- Huang, C. Y., Nonadiabatic processes in the Earth's magnetotail, *Proc. First International Conf. on Substorms*, ESA publications division, 535, 1992.
- Huang, C. Y., Nonadiabatic processes in the Earth's magnetotail, *Adv. Space Physics*, edited by W. -H. Ip, 1993.
- Pulkkinen, T. I., D. N. Baker, D. G. Mitchell, R. L. McPherron, C. Y. Huang, and L. A. Frank, Global and local estimates of the current sheet thickness: CDAW-6, *Adv. Space Res.*, **13**, 485, 1993.
- Song, P., C. T. Russell, and C. Y. Huang, Wave properties near the subsolar magnetopause: PC 1 waves in the sheath transition layer, *J. Geophys. Res.*, **98**, 5907, 1993.
- Huang, C. Y., and L. A. Frank, A statistical survey of the central plasma sheet, *J. Geophys. Res.*, **99**, 83, 1994.
- Pulkkinen, T. I., D. N. Baker, D. G. Mitchell, R. L. McPherron, C. Y. Huang, and L. A. Frank, Thin current sheets in the magnetotail during substorms: CDAW-6 revisited, *J. Geophys. Res.*, **99**, 5793, 1994.
- Huang, C. Y., and L. A. Frank, Magnitude of B_z in the neutral sheet of the magnetotail, *J. Geophys. Res.*, **99**, 73, 1994.
- Lyons, L. R., and C. Y. Huang, Plasma sheet expansion at $R = 15$ to 22 RE: A recovery phase or expansion phase phenomenon?, *J. Geophys. Res.*, **99**, 10995, 1994.
- Parks, G. K., R. Fitzenreiter, K. W. Ogilvie, C. Huang, K. A. Anderson, J. Dandouras, L. Frank, R. P. Lin, M. McCarthy, H. Reme, J. A. Sauvaud, and S. Werden, Reply, *J. Geophys. Res.*, **99**, 13541, 1994.
- Chaston, C. C., Y. D. Hu, B. J. Fraser, R. C. Elphic, and C. Y. Huang, Electromagnetic ion cyclotron waves observed in the near Earth plasma sheet boundary layer, *J. Geomag. Geoelectr.*, **46**, to be published, 1995.

Seon, J., L. A. Frank, A. J. Lazarus, and R. P. Lepping, Surface waves on the tailward flanks of the Earth's magnetopause, *J. Geophys. Res.*, **100**, 11907, 1995.